

Initial Surgeon Training for Single Port Access Surgery: Our First Year Experience

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ABSTRACT

Background: We have developed a single port access (SPA) surgical technique that allows for procedures to be done through a single umbilical port incision <20 mm in length. For a new approach to be universally beneficial, it needs to be easily learned and applied.

Methods: Single port access abdominal procedures are performed through one umbilical incision where skin and soft tissue flaps are raised from the underlying fascia to allow insertion of up to 4 instruments. Fifty surgeons with varying degrees of laparoscopic training participated in SPA training programs at Drexel University to learn and apply the SPA technique through participation in an animate (porcine) laboratory.

Results: All surgeons successfully performed the SPA access technique without difficulty and completed the cholecystectomy in <55 minutes (average, 42). Eight surgeons successfully performed placement of a cholangiogram catheter. All recognized the value of a formal training symposium to learn SPA techniques before performing SPA procedures in their practice.

Conclusions: The SPA technique has been successfully shown to be an approach that is easily learned and accomplished. We believe this is a necessary and important bridge towards proficiency in performing SPA procedures in clinical patients.

Key Words: Single port access, Surgical training, SPA, Laparoscopic cholecystectomy, LESS surgery, Single incision laparoscopic surgery.

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Disclosure: Paul G. Curcillo II MD: Storz, Ethicon, Olympus, Microline

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INTRODUCTION

The desire to continually improve on the minimally invasive surgical approach to disease is evidenced in part by a focus on reducing the number and size of incisions required for laparoscopic surgical procedures. Laparoscopic surgery was initially introduced at the beginning of this century by Dimitri Ott, Georg Kelling, and Hans Christian Jacobeus. Erich Muhe performed the first laparoscopic cholecystectomy in 1985 paving the way for the advancement of laparoscopy within the field of general surgery.¹ Minimally invasive surgery is now performed with faster recovery times, improved cosmetic results, and reduced postoperative pain.²

The trend toward decreasing the number of incisions was seen in 1995, with surgeons from France reporting the successful completion of 655 laparoscopic cholecystectomies with 3 trocars.³ In 1997, Navarra performed a one-wound laparoscopic cholecystectomy with transabdominal sutures.⁴ In 2001, 70 laparoscopic cholecystectomies were performed with 2 trocars.⁵ In 2004, Kallou⁶ et al performed the first natural orifice transluminal endoscopic surgery (NOTES) in which there were no abdominal incisions. In 2005, studies were conducted demonstrating successful transgastric cholecystectomies in pigs.⁷

In April 2007, we developed Single Port Access (SPA) surgery, a technique to allow minimally invasive surgery to be performed entirely through a single incision. In May 2007, we performed the first successful SPA cholecystectomy in which the entire procedure was performed through the umbilicus as the only portal of entry.⁸ This SPA approach is applicable to a number of minimal access surgical procedures using the umbilicus as the only portal of entry. We have now begun reporting our series of SPA procedures, because we are able to evaluate results and outcomes 2 years into the development of Single Port Access Surgery as opposed to initial case reports.^{8,9}

However, for a new surgical approach to be universally beneficial and ultimately applied by many surgeons to large series of patients, a new technique needs to be easily learned and reproducible by other surgeons. Our goal was to develop a training program to teach and validate the SPA procedure and technique as a viable option for sur-

geons to learn and perform laparoscopic surgery for surgical disease. We have developed a training program for independent surgeons to learn the SPA technique by performing a laparoscopic cholecystectomy in the porcine model. This training program provided the means to assess and evaluate the issues of learning the SPA technique and prove reproducibility as a stepping-stone towards surgeon proficiency in performing SPA procedures in human patients.

MATERIALS AND METHODS

A total of 50 practicing surgeons, participated in 8 Single Port Access Surgery training symposiums. The program offers a didactic description of the development of SPA surgery, the approach to a novel access technique and instrumentation available. SPA training sessions were held in the Drexel University Minimal Access Surgical Training Center in conjunction with the Drexel University Laboratory Animal Resources (ULAR). The didactic portion consisted of 90 minutes of lecture and exposure to Single Port Access (SPA) surgery. The focus of this portion of the training was spent on demonstrating this novel access technique. Following this, an animate laboratory was offered to allow each surgeon to experience the SPA technique and perform a familiar procedure, the cholecystectomy. In some cases, a surgical resident familiar with the development of SPA acted as first assistants. Surgical residents were instructed to only assist the primary surgeon in retraction and not perform any components of intraoperative dissection. The procedure times were measured from the start of the procedure with skin incision to successful detachment of the gallbladder. Closure was not included in the operative times. Surgeons were not informed that their performance was being timed. To conclude the training symposium, a roundtable discussion and debriefing was held with each surgeon to assess feedback.

Surgical Technique

Single Port Access (SPA) cholecystectomy is performed through a single umbilical incision measuring 14mm to 20mm in length within the umbilicus. An initial clear 5mm trocar is inserted in an open technique through an umbilical incision followed by the insufflation of the abdominal cavity with carbon dioxide. Skin and soft tissue flaps are raised off the fascia through blunt dissection lateral to the initial trocar in both directions for approximately 2cm within the same skin incision. A 5-mm 30-degree laparoscope is then inserted into the initial trocar and angled to

the right and left of the trocar to enable visualization of the insertion of two *very-low* profile 5-mm trocars that are inserted 0.5cm to 1.0cm lateral and superior to the central trocar in a “triangulated” fashion. This arrangement allows for “independence of movement” of each instrument during the dissection. An optional additional fascial incision is made 5mm inferior to the initial trocar to allow a single grasping instrument to be inserted without a trocar (**Figure 1**).

The camera is routinely placed through the central trocar, and the lateral trocars are used for the 2 dissecting instruments, clip applicator, and electrocautery dissection instrument (**Figure 2**). Both rigid and articulating instrumentation is available to the surgeons. The gallbladder is dissected in the standard fashion of a multiport cholecystectomy. Gallbladder retrieval is through the umbilical incision.

RESULTS

All 50 surgeons successfully completed a SPA cholecystectomy procedure with an average of 42 minutes. The fastest performance was 25 minutes and longest 55 minutes. Surgeons were not required to perform an intraoperative cholangiogram, but all 8 of the 8 surgeons who did attempt placement of an intraoperative cholangiogram catheter did so successfully and without any intraoperative complications. Six surgeons used 2 operating dissecting instruments, and the remaining 44 surgeons elected to use a third instrument placed inferior to the central trocar to aid in the dissection as previously described. Overall, there were no intraoperative complications with each op-

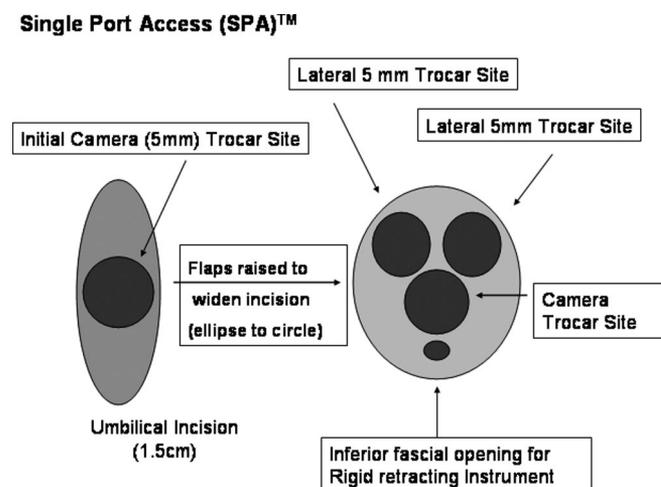


Figure 1. Schematic of the Single Port Access technique (incision and placement of trocars).

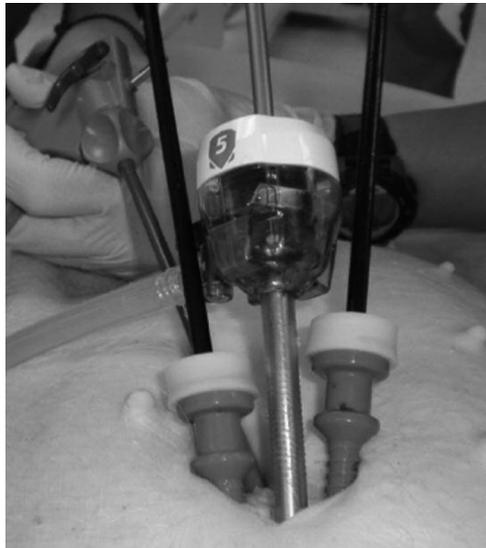


Figure 2. External view of the laparoscope placed in the central trocar and lateral trocars for 2 dissecting instruments.

eration. Early in the program, articulation was used in the 2-instrument technique, but with the adoption of the third retraction instrument, rigid instruments have been preferred by trainees.

DISCUSSION

The specific goal of SPA surgery is to comfortably and safely perform a surgical procedure through a single, often hidden, skin incision. A more universal goal of any new technique is its reproducibility by other surgeons. Here, we demonstrate what we believe is the first step in learning a new procedure—reproducibility in a training laboratory. Once a surgeon is familiar with the single port approach to laparoscopy, the transition process from multiport through reduced port to single port surgery can begin in patients.

The SPA technique can be done successfully and safely by first having surgeons learn the SPA procedure in a training course using a porcine model. The porcine model provides similar intraabdominal anatomy to that of humans, and more importantly offers an adequate means of practicing the most crucial part of SPA surgery: the SPA access technique and placement of trocars through one incision in the abdominal wall in the umbilicus.

All 50 practicing general surgeons have an active laparoscopic practice, and during the symposium each was trained in the use of SPA surgical techniques. Some had no prior experience, and others had some exposure to the

procedure in one form or another. No surgeon had performed more than 5 single-port procedures before our training lab.

Although the laparoscopic cholecystectomy in a porcine model has not been shown to clearly correlate with the procedure in humans, we felt that once the access technique was used, the surgeon could experience the nuances of the single-port approach by performing a procedure familiar to them. Although we draw no correlation to the ability to perform a SPA cholecystectomy in a porcine model to successful application in patients, we do believe this is the first step in exposure to a new technique. It is certainly safer to perform a novel procedure in the laboratory first, before moving directly to patients.

Two variables will theoretically decrease the operative time in the porcine model versus human patients. First, the cystic duct in the porcine model is a single long duct that is identified along the posterior-inferior border without any confusion as to the common bile duct or hepatic duct. Thus, there is less dissection needed in clearly identifying the cystic duct in pigs, decreasing our observed procedure times. Second, the length of time that the surgeons needed to close the skin after removal of the gallbladder was not included. Although we did not include this, we believe that most general surgeons would be able to accomplish this relatively quickly, safely, and in a similar fashion. Overall, what we feel is important is *not* necessarily the overall times of procedure performance and anatomical discrepancies between pigs and humans, but rather to evaluate the feasibility in using the porcine model as a means of training surgeons on the SPA technique so that surgeons may reproduce the SPA method to a variety of laparoscopic procedures.

To conclude the training symposiums, a roundtable discussion and debriefing was held for all surgeons to obtain feedback regarding positive and negative aspects of the training sessions as well as suggestions for improvement. All surgeons were comfortable in establishing single-port access without difficulty. All surgeons described learning the technique and performing a SPA cholecystectomy as a “moderate learning curve.” In addition, most surgeons were satisfied with the amount of training that the symposium offered to learn all of the necessary tools to be able to perform the procedure. Suggestions for change include increasing the number of training sessions and improving them by using cadavers as the test model. In addition, using 3-dimensional computer simulations for the dry laboratory would be a useful adjunct in training.

Feedback also emphasized that future training of SPA techniques on the porcine model in the symposium should require the placement of an intraoperative cholangiogram catheter for SPA cholecystectomies. In addition, the symposium should expand into other SPA abdominal procedures. Subsequently, our training programs have allowed the performance of placing cholangiogram catheters and other intraabdominal procedures following the cholecystectomy (hence closure was not included in the time to completion). To date, we have seen the successful completion in initial trainees' experience of SPA Nissen funduplications, gastric banding, gastric tubes, and splenectomies.¹⁰

The important next steps in the process of training on this novel minimal access platform will be assessing the next steps in training as well as assessing adoption into practice by surgeons completing the training program. With regards to the next steps, we strongly advocate that surgeons proceed with *reduced port* surgery as a transition step. Once familiar with the SPA technique, we recommend to our trainees that they begin the process by eliminating the subxyphoid port and performing the dissection through the umbilicus with the dissecting instrument, clip applier, and scissors being placed through the lateral trocar in the umbilical skin incision. After successful completion and comfort with this, the medial port on the right abdominal wall is then transitioned to the umbilical incision as well, maintaining fundal retraction

through the lateral port site. Finally, the lateral port site is eliminated, and the fundal retractor is moved to the six o'clock position as in the final SPA technique set up (**Figure 3**).

Attention through all steps is to maintain safe dissection and attention to safe aspects of laparoscopy. In cholecystectomy, attention to the critical view is mandatory. Also, Single Port "rescue" should always prompt the addition of subsequent ports if necessary.

CONCLUSION

As laparoscopic surgery has revolutionized the field of general surgery within the last 2 decades, other techniques, such as Single Port Access surgery and NOTES, have built upon the principles of minimal access surgery. SPA surgery offers a new technique that may be performed successfully in laparoscopic abdominal procedures while offering the patient a single "hidden" incision within the umbilicus. The ability to successfully teach practicing surgeons the techniques of SPA surgery is seen effectively in this study, and this approach is easily learned and reproduced. This may pave the way for future symposiums to serve as a valuable and educational training model to teach SPA surgery, and to serve as a bridge to surgeon proficiency in performing SPA surgery in human patients.

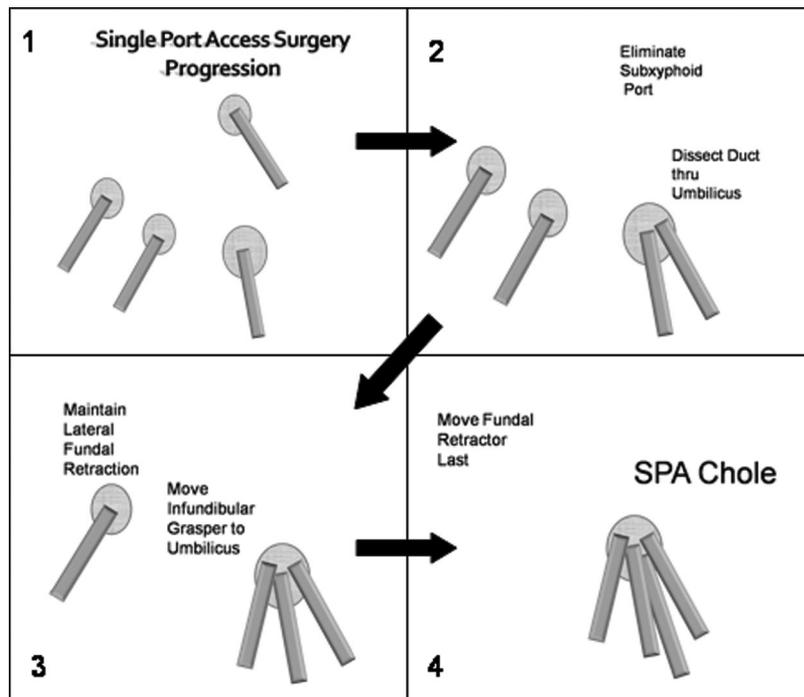


Figure 3. Four-step procedure to learning the Single Port Access reduced port technique.

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